

## COMPARATIVE ETHNOMYCOLOGICAL SURVEY OF THREE LOCALITIES FROM LA MALINCHE VOLCANO, MEXICO

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**ABSTRACT.**—With the objective of making a comparative ethnomycological study, we selected three communities: Ixtenco, where the population is Otomi in origin; Javier Mina, where the people are of Nahua ancestry; and Los Pilares, a community of mixed Indian and Spanish descent (mestizos). These towns are located on the slopes of the Malinche Volcano in the eastern part of the State of Tlaxcala and were visited periodically from 1988 to 1992. The information was obtained by two methods: interview and questionnaire. Journeys into the forest were made with some of the respondents. We interviewed 191 people and obtained 495 completed questionnaires. In each community, we obtained biological, ecological and phenological data, as well as information on the local people's concepts and uses of mushrooms, especially those which were considered to be edible or toxic.

**Key words:** ethnomycology, wild mushrooms, Otomies, La Malinche National Park, Tlaxcala.

**RESUMEN.**—Con el objeto de realizar un estudio etnomicológico comparativo se seleccionaron tres comunidades: Ixtenco, cuya población es de origen otomí; Javier Mina, en donde los pobladores son de ascendencia nahuatl y Los Pilares, comunidad habitada por gente mestiza. Dichas poblaciones se ubican en la parte oriental del estado de Tlaxcala al pie del Volcán La Malinche, y fueron visitadas periódicamente entre 1988 y 1992; la información se obtuvo a través de dos mecanismos: entrevistas y cuestionarios. Se realizaron salidas al bosque en compañía de algunos informantes. Se entrevistó a un total de 191 personas y se completaron 495 cuestionarios. En cada una de las comunidades se obtuvieron datos sobre la biología, ecología, fenología, las concepciones acerca de los hongos y su utilización por la gente local, principalmente de los que se consideran comestibles o tóxicos.

**RÉSUMÉ.**—Avec l'objectif de réaliser une étude ethnomycologique comparative, on a sélectionné trois communautés: Ixtenco, dont la population est d'origine Otomi; Javier Mina, dans laquelle les colonisateurs sont d'ascendance Nahua; et Los



Pilares, une communauté habitée par des métis (mestizos). Ces populations se trouvent dans la partie orientale de l'état de Tlaxcala, au pied du volcan La Malinche, et on été visitées périodiquement entre 1988 et 1992. L'information a été obtenue par deux mécanismes: entrevues et questionnaires. On a réalisé des sorties en forêt en compagnie de quelques informateurs. On a réalisé un total de 191 entrevues et reçu 495 questionnaires. Dans chacune des communautés données ont été obtenues sur la biologie, écologie, phénologie, idées et usages des champignons, principalement des comestibles et de ceux considérés toxiques.

## INTRODUCTION

A growing interest has developed during the last decade in assessing the importance of mushrooms to Mexican people. Many studies have shown that indigenous Mexican people have a wide knowledge of the biology, ecology, phenology, nomenclature, and use of these organisms (Chacón 1988; Dubovoy 1968; Escalante 1982; Escalante and López-González 1971; Estrada-Torres and Aroche 1987; Gispert et al. 1984; González-Elizondo 1991; Guzmán 1960; Mapes et al. 1981; Martínez-Alfaro et al. 1983; Palomino-Naranjo 1992; Reygadas-Prado et al. 1995).

Mexico is a multiethnic country and is home to around fifty Indian groups (Toledo et al. 1985). In addition, the country has a great richness of mushroom species as a consequence of the wide variety of environments found in its territory. Nevertheless only a few ethnomycological studies have been completed (Villarreal and Pérez-Moreno 1989).

No study has been made on the mycological knowledge of people from the State of Tlaxcala, Mexico, but there is some evidence suggesting that the earlier Nahuas of the region knew the edible and hallucinogenic properties of some mushroom species (Muñoz-Camargo 1586). No information is available about the knowledge of the Otomi who have inhabited this area since pre-Cortesian times (Gibson 1991), though some information is available for several species of edible mushrooms which are eaten and sold in the markets of Tlaxcala (Herrera and Guzmán 1961; Estrada-Torres et al. 1991; González-Fuentes 1987; Santiago-Martínez et al. 1990; Villarreal and Pérez-Moreno 1989). Tlaxcala is one of the most culturally influential states of Mexico as a result of the hybridization of Spanish and indigenous traditions following the Conquest. Nevertheless, several communities in the territory of Tlaxcala retain their indigenous Nahua identity. People from several towns on the slopes of La Malinche volcano (known locally as Volcán La Malintzi) continue to speak Nahua and preserve their own traditions. In addition, Ixtenco is an isolated Otomi village in the west of Tlaxcala, which has had a different linguistic and cultural evolution from the rest of the Otomi communities of Central Mexico (Weitlaner 1933). Most of the inhabitants of these towns live near forest patches and collect different forest products, such as wood and mushrooms, mainly for personal use. Taking these factors into account, the purpose of our study was to compare traditional mycological knowledge of the people from three towns situated on the slopes of the Malinche Volcano, Tlaxcala.



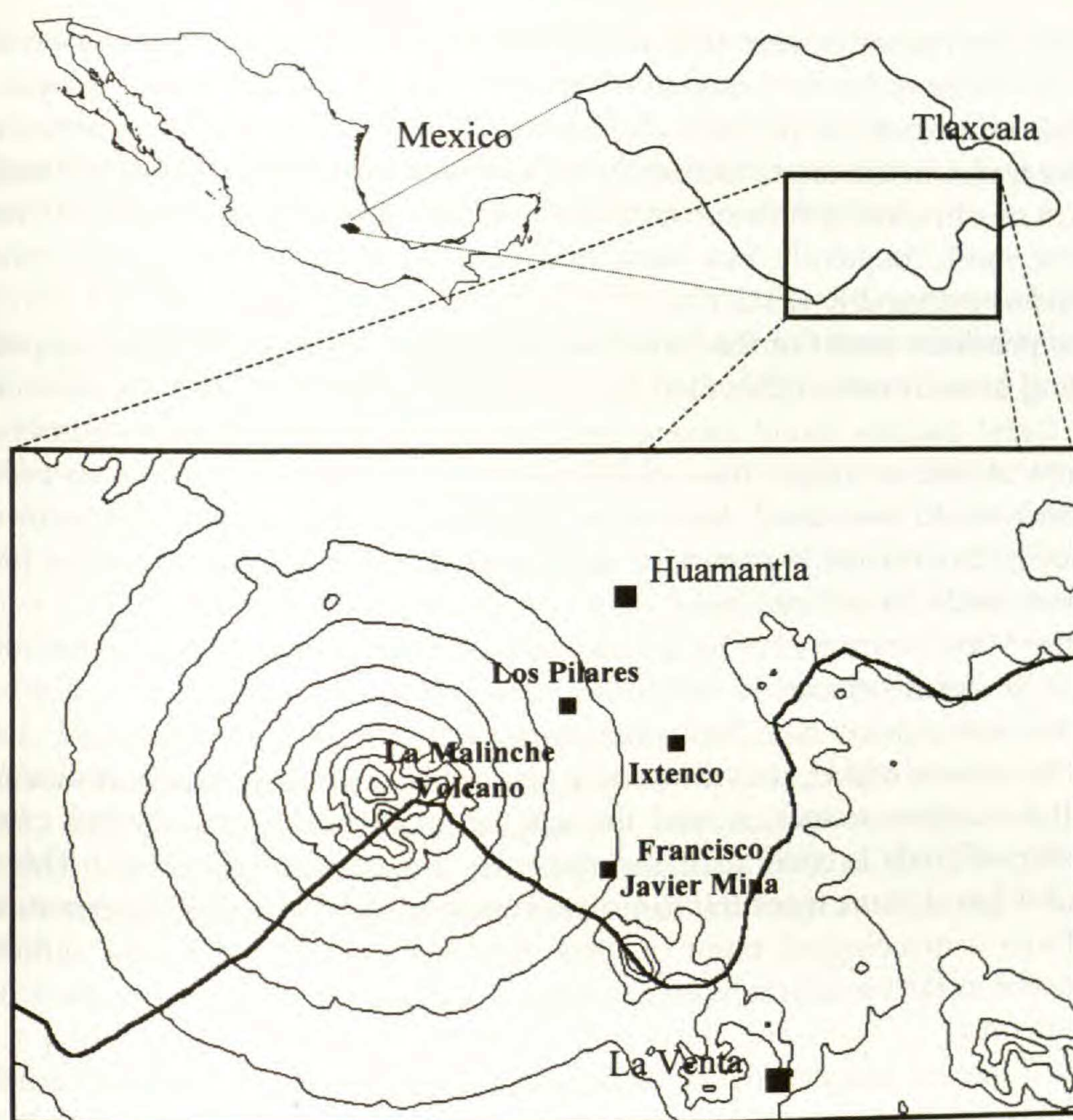


FIGURE 1.—Map showing the selected towns (Ixtenco, Javier Mina, and Los Pilares) and surrounding areas.

### AREA OF STUDY

Malinche Volcano is an isolated mountain in the central part of Mexico. It lies along the border between the States of Puebla and Tlaxcala. The Malinche has the fifth highest elevation of the country, 4460 m, and was declared a national park in 1938 with a total area about 17,612 km<sup>2</sup> (Coordinación General de Ecología 1995). There are many small towns on the slopes of the Malinche Volcano and their inhabitants use the natural resources of the mountain in spite of it being a national park. While the municipalities of Huamantla, Ixtenco and Trinidad Sánchez Santos have their territories within the national park, the borders between them are not clearly defined. Most of the land on the Volcano is communal property, but some people own private properties. The three selected towns are located in the southeastern part of the State of Tlaxcala, and can be approached by way of Huamantla-La Venta federal road (Figure 1).

Ixtenco belongs to Ixtenco municipality and is situated at 19°14'54" north latitude, 97°54'30" west longitude and at an elevation of 2592 m. In 1990, Ixtenco had 5356 inhabitants: 2781 male and 2575 female. Agriculture is the main activity of the population. There were 753 Otomi speakers in that year. Ixtenco is about 8



km from the nearest forest and the people depend in various ways on forest resources. Water is the most important forest resource for the Ixtenco people, who go to the forest only to fix their old, locally-built aqueduct, which carries water from the forest to the town. Generally, they do not spend time going to the forest to collect mushrooms, plants or wood because they collect their supplies in nearby places or, more frequently, buy them in the town. These people have communal land (*ejidos*) principally (2312 ha).

The previous extent of the forest seems to have been greater than at present, according to information provided by older people, and also as it can be inferred by the forest patches found among agricultural fields belonging to Ixtenco. The habitants of Ixtenco might have made more use of forest resources in previous times and would have used them more frequently. Some people of this town say that they had never really depended on forest resources because they had farmed their own lands for a long time.

Javier Mina forms part of the municipality of Trinidad Sánchez Santos, located at 19°11'18" north latitude, 97°55'33" west longitude, at an elevation of 2540 m. In 1990, this municipality had 7847 inhabitants: 4022 female and 3825 male. According to the census report, only 59 people spoke Nahuatl. The main activities were agriculture, cattle production, and the sale of mushrooms; also in this case, the ownership of lands is communal and there are a few *ejidos* (487.05 ha). This town is about 4 km distant from the forest and people harvest forest resources regularly. From a mycological point of view, this fact is reflected by the number of people who collect mushrooms for eating or for selling in the markets of neighboring towns.

Los Pilares is situated in the Huamantla municipality, at 19°16'12" north latitude, 97°56'42" west longitude and at an elevation of 2680 m. Los Pilares had 845 inhabitants in 1990, comprising 421 males and 424 females (INEGI 1991). The main activities were cattle production, agriculture, manufacturing and sale of goat cheese, and marketing of several foodstuffs, mainly tortillas and seeds. In this town, most of the land is also communal (981.25 ha), but some people own land. The town is about 4 km distant from the forest and people use forest resources continuously; mushroom collectors sell their harvest in the market of Huamantla.

*Weather.*—According to the data of Huamantla Meteorological Station and using the Köppen Climatic Classification, the type of weather in the study area is C(W<sub>2</sub>)(w), subhumid with rainy season in summer (INEGI 1986); the pressure/temperature ratio is 41.9 and there is low annual variation in average monthly temperature, with fluctuations between 5° and 7°C. The annual mean temperature is 15.3°C. May is the hottest month (mean temperature = 17.7°C) and January is the coldest (mean temperature = 11°C) (García 1988).

*Vegetation.*—Coniferous forest is the dominant kind of vegetation. Below 3000 m we find pine forest with the following species: *Pinus leiophylla* Schl. & Chamb., *Quercus rugosa* Neé, *Q. laurina* H. & B., *Arbutus jalapensis* HBK., and *P. teocote* Schl. & Chamb. The pines *P. montezumae* Lamb. and *P. teocote* are mixed with *Alnus jorullensis* HB&K., *Salix mexicana* Seemen, *S. paradoxa* HBK., *S. oxylepis* Schn., *Buddleia parviflora* HBK., *Ribes ciliatum* H. & B., and *Abies religiosa* (HBK.) Cham. & Schl. The dominant species in the herbaceous stratum are: *Lupinus aschenbornii*



Schauer var. *furcillata*, *Castilleja tenuiflora* Benth., *Penstemon gentianoides* (HBK.) Poir., *Baccharis conferta* HBK., *Eupatorium glabratum* HBK., *Asclepias ovata* Mart. & Gal., *Senecio cinerarioides* HBK., *Senecio salignus* DC., *Cirsium ehrenbergii* Sch. Bip., *Gnaphalium americanum* Mill., *Acaena elongata* L., *Alchemilla procumbens* Rose, *Prunella vulgaris* L., *Argemone platyceras* Link & Otto, and *Reseda luteola* L.

The main grasses in open areas in the *Pinus*–*Abies* forest, are: *Stipa ichu* (Ruíz & Pavón) Kunth., *Muhlenbergia macroura* (HBK.) Itchc., and *Eragrostis bartieri* Dar. In the agricultural fields it is possible to find scattered trees of *Buddleia cordata* HBK., *Alnus jorullensis* HBK., *Crataegus pubescens* (HBK.) Steud., and *Prunus serotina* Her. (Acosta and Kong 1991).

Above 3000 m, the forest is dominated by *Abies religiosa*, frequently mixed with *Pinus hartwegii* Lindl. or with *P. montezumae*. In the lower stratum, some shrubs and trees are found: *Salix mexicana*, *S. paradoxa*, *Buddleia parviflora*, *Ribes ciliatum* H. & B., and *Prunus serotina* ssp. *capuli* (Cav.) Mc Vaugh (Acosta and Kong 1991). In the herb layer the dominant species are: *Cirsium ehrenbergii*, *Gnaphalium americanum*, *Taraxacum officinale* Weber, *Pernettya ciliata* (Schlecht. & Chamb.) Standl., *Halenia plantaginea* (HBK.) Griseb., *Geranium semanii* Peyr., *Prunella vulgaris*, *Alchemilla procumbens*, *Phacelia platycarpa* (Cav.) Spreng., *Habenaria limosa* (Lindl.) Hemsl., *Didymaea alsinoides* (Sch. & Chamb.) Standl., *Rumex acetosella* L., *Galium aschenbornii* Schauer., *Poa annua* L., *Plantago major* L., *Viola painteri* Rose & House, *Solanum demissum* Lindl., *Bacopa procumbens* (Mill.) Grenm., and *Eryngium carlinae* Delar. F.

Above 3500 m, the *Pinus* forest contains pure stands of *Pinus hartwegii* together with some individuals of *Alnus jorullensis* and *Abies religiosa*. The main shrubs are *Baccharis conferta*, *Senecio cinerarioides*, *S. salignus*, *Lupinus montanus*, *Salix oxilepis*, *Ribes ciliatum*, and *Eupatorium glabratum*. Plants of the herbaceous layer include: *Bacopa procumbens* (Mill.) Greenm., *Senecio platanifolius* Benth., *Muhlenbergia macroura*, *Penstemon gentianoides*, *Pernettya ciliata*, *Habenaria limosa*, *Milla biflora* Cav., *Castilleja scorzonifolia* HBK., *Solanum demissum* Lindl., *Stevia monardifolia* HBK., *Pedicularis canadensis* L., *Ranunculus macranthus* Scheele., *Arenaria lycopodioides* Will. Ex. Sch., *Cyperus incompletus* (Link.) Jack., *Trifolium goniocarpum* Lojac., and *Stenanthium frigidum* (Scham. & Schlencht.) Kunth (Acosta and Kong 1991).

## MATERIAL AND METHODS

The southeastern slope of the Malinche Volcano was visited every 15 days from May of 1988 to November of 1991. The people who were found collecting mushrooms were interviewed in order to find out where they came from and the purpose of their collecting (home consumption or for sale). Three towns were selected, taking into account the ethnic origin of populations: Ixtenco, an Otomi town; Javier Mina, a town inhabited by Nahua people (although we did not find any Nahuatl speakers); and Los Pilaes, a small mestizo town.

Interviews included questions designed to elicit responses on several topics of mycological knowledge: conceptions about what a mushroom is, vernacular names, uses, conceptions about phenology and ecology, classification in the "cold-hot" system, methods of cooking, and poisonous mushrooms. These interviews were made with people who agreed to collaborate; we walked around each vil-



TABLE 1.—Total of interviews and questionnaires carried out in each town.

Community name	Total questionnaires	Interviews	Total population	Interviews % related to total population
Ixtenco	390	92	5980	8.0
Javier Mina	31	43	606	12.2
Los Pílares	74	56	460	28.6

lage, knocked at each door, and interviewed people who answered our questions. At least 10% of the people from Javier Mina and Los Pílares were interviewed and 8% from Ixtenco. The information obtained was recorded on audiotapes when the respondents were Otomi speakers.

Several questionnaires were prepared with the purpose of amplifying and confirming the information obtained from the interviews. These questionnaires were distributed in the schools of each town. Some students were asked to answer the questions on the spot, and other students were instructed to carry questionnaires home and request their parents or another relative to answer the questions. Responses to a few questionnaires were obtained this way. We obtained written information principally from young people (9–16 years), but interviews were held with people 17 to 90 years old. Questions in interviews and questionnaires were the same (Appendix 1). The answers to each question were grouped by categories and the data was converted to percentages. In order to compare interviews and questionnaires the information was processed independently.

Some “main respondents” were selected in each town. These respondents were people with a wide knowledge about the mushrooms from forests near their towns. Field forays for collecting mushrooms were made in the company of these persons.

The mushrooms were collected, identified and catalogued. The voucher specimens were deposited at the herbarium of Universidad Autonoma de Tlaxcala (TLXM).

RESULTS

Table 1 shows the number of interviews carried out and questionnaires completed in each town.

We elicited 121 common names of 41 edible species in the three towns (Appendix 2). Ixtenco people know 25 useful species and use 70 common names (52 in Spanish, 3 in Nahuatl, 2 mixed names and 13 in Otomi). Javier Mina people reported 38 species and 104 common names (90 in Spanish, 8 Nahuatl and 6 mixed names). Los Pílares people know 25 species and 52 common names (48 in Spanish, 2 in Nahuatl and 2 mixed names).

*Ideas about What a Mushroom Is.*—In the three communities, there are some evident differences in people’s ideas regarding the nature of mushrooms. The most common idea in Javier Mina and Los Pílares is that mushrooms are different from plants and animals. People said, “nada más son hongos” (they are just mushrooms), a concept similar to that which has been established in modern mycology



(Margulis 1974). The percentage of people who gave this answer was higher than that for other concepts. Information was obtained through both questionnaires and interviews, but it was felt that the most accurate information was obtained through discussions with the interviewees. In Ixtenco, only 8% of the people interviewed said mushrooms were neither plants nor animals, but 38% considered mushrooms to be plants. Because of the use of many technical words (e.g., "cryptogamous plants") when students referred to mushrooms as plants, or to some fungi structures (scales as "hoyos ingestales," "píleo," "himenio") and some Latin names ("Boletus satanas," "Amanita muscaria") it could be supposed that young people's ideas about the nature of mushrooms has been influenced by information learned in school. Interviews showed that many people who had never attended school also considered mushrooms to be plants. Otomi people of Ixtenco use the classifier *kho* or *y'kho*, which means mushroom, and they include the fungal condition athlete's foot in the category of mushroom. However they use the word *I'm d'ga* to refer to plants and *fani* to animals.

Other ideas in Javier Mina and Los Pilares are: "los hongos son agua" (the mushrooms are water) or "son producto de la tierra" (they are a product from the soil). The former view is based on the high content of water of the sporophores. For those who hold the latter view, mushrooms are considered a different kind of natural element unrelated to both plants and animals.

The value of mushrooms in the diet of the Javier Mina's people is reflected when they state, "los hongos son un alimento" (mushrooms are a kind of food).

*Placement of Fungi in the Cold-Hot System.*—Classifying food and other elements of the universe as "cold" or "hot" is an ancient tradition in America. It is based on the characterization of the humor and paired qualities of food as hot or cold, and dry or humid. From this point of view, food is eaten not just for nutrition, but also to treat certain kinds of illness and to promote health. For example, a person suffering from a fever should eat cold food, while someone suffering from a cold should consume hot food (Foster 1979). Some foods that are considered as hot are: meat, honey and coffee. Rice, papaya, watermelon and mushrooms, among others, are cold food. Most of the respondents of the three communities consider mushrooms to be *fríos* 'cold', either because of their high water content or the place in which they grow, frequently in wet places. Some respondents replied: "Son fríos porque crecen en el monte y ahí hace frío" (they are cold because they grow in the forest and it is cold there). Sometimes people classify mushrooms as cold because they think mushrooms produce vomiting or diarrhea when eaten in abundance or during the night. The recommendation of some women is to cook mushrooms with *epazote* (*Chenopodium ambrosioides* L.) or drink some kind of tea after eating them, because they are hot. Consequently, it is thus possible to obtain a balance of cold and hot in a mushroom meal, which is considered to be healthy.

Some people of Ixtenco and Javier Mina regard some kinds of fungi as *calientes* 'hot', *tibios* 'warm', or *templados* 'temperate'. In Javier Mina, some respondents stated that *Ustilago maydis* is hot because it grows on maize, and the stem absorbs the humidity, while the other mushrooms grow on the soil.

*Morphology.*—People from the three communities recognize various types of fruiting body, which are distinguished from one another by their general morphology:



mushrooms with an umbrella shape (gilled mushrooms), *pantes* and *pancitas* (boletes), *escobetas* 'brooms' (coral-like mushrooms), *bolitas o pedos de coyote* 'little balls or coyote farts' (puffballs), *chipotles* (morels), *hongos de repisa* 'shelf mushrooms' (polypores), and *papas* 'potatoes' (truffle-like mushrooms).

In the three communities, the different structures which make up a mushroom were named. In Ixtenco, both the Otomi and Spanish names were given for the following structures: cap, cuticle, gills, scales, stipe, and ring.

Only in Javier Mina were all the structures of a typical mushroom recognized; in Ixtenco and Los Pilares the volva remained unnamed. The most frequent names used to refer to the hymenium were *costillas* 'ribs', *esponja* 'sponge', and *libro* 'book'. These were mentioned in the three localities, as well as *sombrero* 'hat', *sombrilla* or *paraguas* 'umbrella', and *cabeza* 'head', which were used for the cap.

The most frequent names employed to refer to the cuticle were *pellejito* 'skin' and *tela* 'cloth'. In all three communities, the names used to refer to the stipe were the following: *tronco* 'trunk', *pata* 'foot', and *tallo* 'stalk'. In Ixtenco the term "stalk" was known by some people and was detected only through the questionnaires.

The ornamentation of the stipe is a feature commonly used by people to distinguish between edible and poisonous mushrooms, for which the following terms were used: *pata lisa* 'smooth foot' and *pata lanuda* 'woolly foot'; these coincide with the technical terms "glabrous" and "tomentose," respectively, which are used in fungal taxonomy.

Other structures, such as scales, ring, rhizomorphs and volva, were not recognized by everyone, but people with knowledge of those mushroom parts had a common vocabulary for them. In Javier Mina, people recognized the volva, the ring, and the scales and associated these structures with the mushroom's development, because they mention that "the skin remains when the mushroom sprouts."

In Figure 2, we show terms used in each town for various structures of gilled fungi. Different terms were used to name the structures of mushrooms without gills. For example, branches from *Ramaria* are known as *bracitos* 'arms', *manitas* 'hands', and *gajitos* 'slices'; puffball scales were named *granitos* 'pimples' or *camisita* 'shirt'; to describe rhizomorphs they say: "los pedos de coyote no tienen patita, están pegados al suelo, tienen una raicita" (coyote farts don't have a foot, they are stuck to the ground, they have a little root). Some of the Spanish names used in one community are not recognized in others. Nevertheless, some of the names are used in two or in all three communities, which may be the result of increased information exchange as mushroom production has become commercialized.

*Origin and Development of Mushrooms.*—We have grouped the ideas about the origin of mushrooms into four categories (Table 2).

The most common idea in the three towns is that mushrooms grow only in the wild without being planted or cultivated. People said, "nacén solos," "se originan solos," or "nacén solos por la naturaleza" (they grow by themselves); "no tienen semilla ni raíz" (they have neither seeds nor roots); "la tierra es la que los produce" (the soil produces them); "brotan de la tierra" (they arise from the



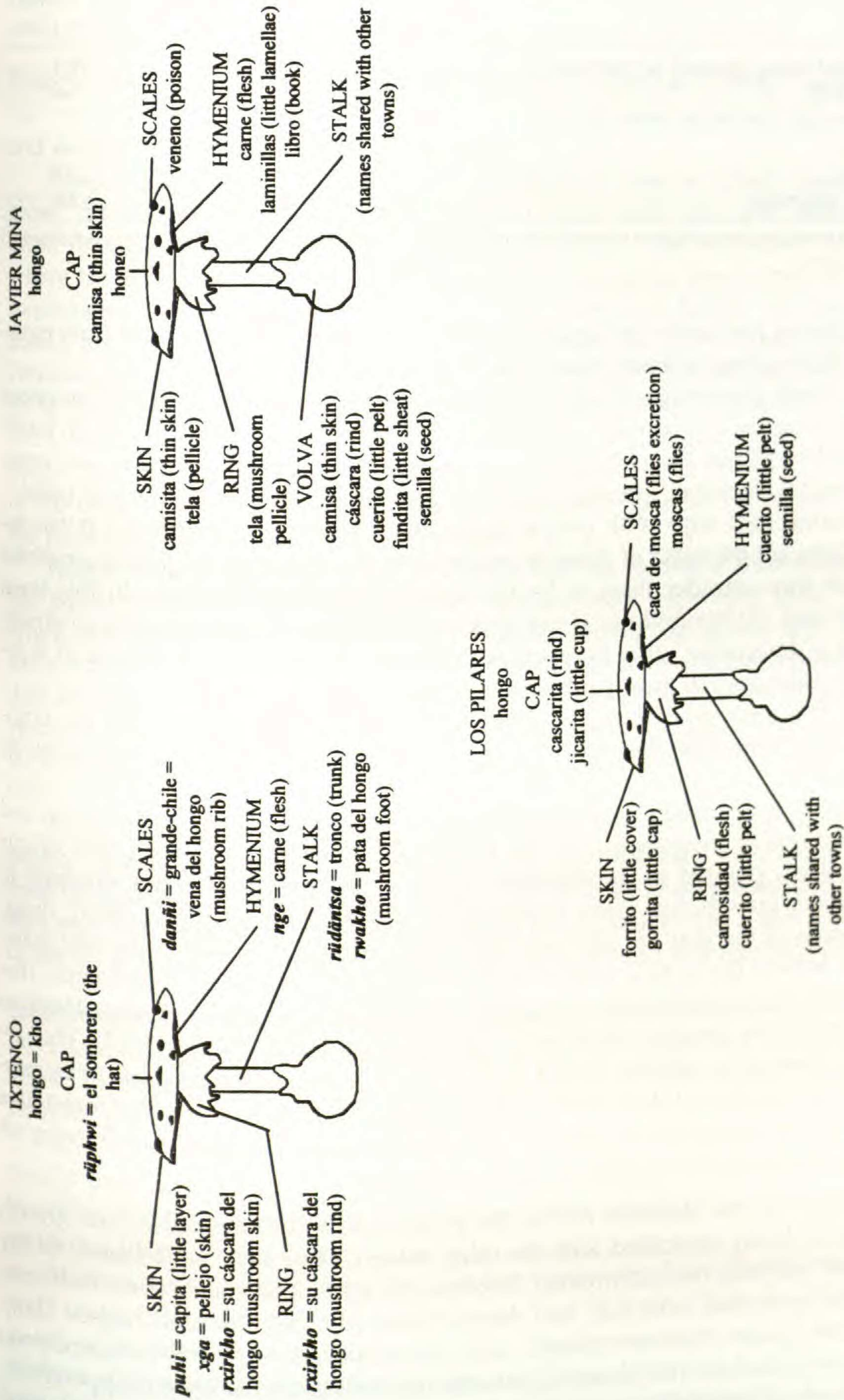


FIGURE 2.—Names for mushroom structures in Ixtenco, Javier Mina and Los Pilares.



TABLE 2.—Mushroom origin.

	Ixtenco (N = 482)	Javier Mina (N = 74)	Los Pilares (N = 130)
Wild (not being planted or cultivated)	63.6	63.8	95.4
God's will	—	1.3	—
Some fungal structures (volva or stipe base)	—	13.0	—
Spores	3.4	—	0.8
Origin unknown	33.0	24.3	3.8

Numbers indicate percentage of respondents who gave each answer. (—) This answer was not obtained in this town.

soil); “nacen por medio del agua” or “de la humedad” (they are born from moisture). These ideas probably mean that they are not planted.

A small percentage of our respondents recognized spores and sporophore structures as the mushroom’s propagules. Both are called *semillas* ‘seeds’. In Ixtenco and Los Pilares the respondents said, “los hongos tienen semillas, son como unas bolitas chiquitas” (mushrooms have seeds, they are like very small balls).

During field trips with people from Javier Mina, we observed that our respondents left the volva of *Amanita caesarea* and the stipe base of *Boletus pinophilus* because they consider them to be the seeds of these mushrooms. In this town people said, “el tronquito es el que produce al hongo, porque si queda enterrado vuelve a desarrollar” (the little trunk produces the mushroom because if it remains underground, mushrooms grow back).

In this community, some respondents answered that mushrooms are originated by Divine Will; they said, “nacen por la voluntad de Dios” (they grow by God’s will).

People in our study area recognize some important factors in the origin and development of mushrooms. In the three communities, more than 50% of our respondents pointed to the moisture (rain) as the principal factor involved in mushroom growth, but many respondents said that *ocoshal* (*Pinus* litter), dung, or seasons of the year are also very important factors. It is interesting that many people believe fire to be a critical factor for the development of mushrooms. This idea indicates a considerable familiarity with the growth habits of some *Hebeloma* and *Lyophyllum* species, which have carbonicolous habits (Moser 1983). This accurate observation induces people to burn the forest with the purpose of increasing the production of these species. In addition, the people know that forest fires promote the production of grasses with which to feed cattle and that burning off the vegetation makes it easier to find mushrooms.

*Phenology.*—In the Malinche towns, the people know that the mushroom growth season is closely associated with the rainy season. They say, “si no llueve, no hay hongos” (no rain, no mushrooms). Most people agree that mushrooms fruit from May to September, with July and August being the months with highest abundance of species. However, people said, “la temporada es variable dependiendo de la precipitación” (the season is variable depending on the rains) (Appendix 3).

People of Javier Mina consider that mushrooms grow throughout the year and group the species into two categories: *hongos de cuaresma* ‘Lenten mushrooms’ or



*hongos de secas* 'mushrooms of the dry season', in which some *Ramaria* and *Lyophyllum* species are included and *hongos de temporal* 'mushrooms of the rainy season', in which most species, both edible and poisonous, are included.

*Ecology.*—The knowledge that people have about mushroom ecology varies from one community to the other. It depends on the activities in which they engage and on their dependence on forest resources.

People from Ixtenco recognize three ecological zones in which mushrooms grow. "El campo" refers principally to agricultural fields and open areas. They often refer also to "el cerro" (the hill) and "el monte" (the mountain, the place where the forest is). In Javier Mina, people also recognize three zones in which mushrooms can be collected: "el campo" (the cultivated fields), "el llano" (the plain), and "el monte" (the forests). In Los Pilares, just two of these zones are considered: "el campo" and "el monte". All the people have the same chance to go to the plain and to the forest, and they can collect plants, mushrooms or wood everywhere, because these are communal lands. Each family owns cultivated fields. The information obtained on this topic is showed in Appendix 4. People of the three towns consider La Malinche (the forest; Spanish: "el monte") to be the principal area for collecting mushrooms.

People from Javier Mina and Los Pilares have an extensive knowledge about the places in which diverse mushroom species grow, especially those species which are sold or used regularly, e.g., *Amanita caesarea*, *Lyophyllum* spp., *Russula delica*, *Ramaria* spp., and *Gomphus floccosus*. Otomi people from Ixtenco gave precise data about few edible species. Some respondents from Los Pilares can easily find certain bodies of hypogeous mushrooms such as species of *Rhizopogon* (*papas* 'potatoes') and they know that some animals such as birds eat these mushrooms. Only a few people eat these species raw, confirming their edibility.

People from Javier Mina call groups of mushrooms of the same species *compañeros* 'mates' or *cuatitos* 'little friends'. They say that each mushroom has its mate because everywhere that one of them grows, there is always another nearby; they say, "son hermanos" (they are brothers). When people find a lone fruit body of *Boletus pinophilus* or *Amanita caesarea*, they look around and usually find more.

*Gathering and Use.*—The main means for obtaining mushrooms in Javier Mina and Los Pilares is through direct collection, but in Ixtenco, people buy them. The two former towns are located very near to the forest, but the latter is more than 8 km from the places in which most species grow.

Most of the people from this area use mushrooms as food. Many people, mainly from Javier Mina and Los Pilares, have developed a commercial activity by selling mushrooms, either in neighboring places or in big cities such as Puebla or Mexico City.

Mushrooms are rarely used for non-food purposes. Nevertheless, we found eight usage categories for mushrooms in the area of study (Table 3). Only a few people recognized most of these categories. Mushrooms represent an important element of the economy of many families from Javier Mina and Los Pilares; however, fewer mushroom uses are recognized in these communities than in Ixtenco. The uses of mushrooms as fuel, decoration, or as an aid in beauty treatments in



TABLE 3.—Usage categories found in the studied area.

	Ixtenco	Javier Mina	Los Pilares
Food	*	*	*
Tinder	*	—	*
Cosmetic	*	—	—
Insecticide	*	—	*
Medicine	*	*	*
Ornament	*	—	—
Item for sale	*	*	*
Poison	*	*	*

(\*) Data obtained in this town. (—) No information recorded in the present survey.

this country have not been previously documented, but these were recorded only in Ixtenco. Only a 23-year old woman indicated the cosmetic use.

*Food.*—A total of 121 common names used to designate 40 species of mushrooms and slime molds were found; these represent 16% of the total number of edible species registered in Mexico (Villarreal and Pérez-Moreno 1989). The use given to each species is variable and depends upon each person’s individual knowledge and preference.

Mushrooms considered to be of excellent quality by most people are the following species: *Amanita caesarea*, *Boletus pinophilus*, *Lyophyllum ovisporum*, *Entoloma clypeatum*, *Hebeloma* aff. *mesophaeum*, and *Ramaria* spp.

The following species were known to over 95% of the inhabitants of the three communities; *Amanita caesarea*, *Boletus pinophilus*, and *Lyophyllum ovisporum*. In Javier Mina, they are greatly appreciated in an immature state (*de botón* ‘bud’), commanding a higher price than those in a more mature state (*floreados* ‘flowered’). These mushrooms are increasingly searched for, and are collected excessively, either for sale or for consumption. On many occasions, however, unsold dried mushrooms may remain stored for many years.

Mushrooms that were greatly appreciated and recognized by at least 40–80% of the interviewed people include the following species: *Cantharellus cibarius*, *Russula delica*, *Hygrophorus chrysodon*, *Gomphus floccosus*, *Agaricus campestris*, *Lactarius salmonicolor*, *Lactarius deliciosus*, *Laccaria bicolor*, and *Helvella lacunosa*.

Many of these species are occasionally collected in an immature state; even though some are avidly searched for, few people recognize them and the carpophores remain uncollected, thus allowing the species to reproduce.

*Amanita franchetii* and *Amanita rubescens* are used only in Javier Mina and few people recognize them. The presence of scales on the surface of the cap of these species is the reason many people consider them to be poisonous. They remain under-used, notwithstanding the high demand and the great appreciation that exists among people who know them.

The species named by less than 40% of interviewees include the following species: *Hygrophorus purpurascens*, *Clitocybe gibba*, *Gymnopus dryophilus*, *Chroogomphus jamaicensis*, *Clavariadelphus truncatus*, *Rhizopogon* aff. *michoacanicus*, *Climacocys-*



*tis borealis*, *Ganoderma* sp., *Lactarius indigo*, *Suillus granulatus*, *Boletus luridiformis*, *Fuligo septica*, *Tricholoma flavovirens*, and *Helvella crispa*.

Some species, such as *Lactarius indigo* and *Boletus luridiformis*, are considered toxic; in the first case, because of its blue-green color, and in the second, because of the greenish color that it acquires when the carpophore is damaged or cut. The last criterion is the same used as that used by people from Acambay in the State of Mexico (Estrada-Torres 1987) and by the Zapotecs from Oaxaca (Hunn, letter 2001)<sup>1</sup>, who distinguish the edible *Boletus* sp. from poisonous species by testing the color of the flesh of the cap. If it turns green when broken, the mushroom is poisonous; if it remains creamy white, it is edible.

Characteristics such as mushroom consistency and shape make some species disagreeable, so people do not consume them. Such is the case with *Rhizopogon* aff. *michoacanicus* which, probably due to its dark and gelatinous gleba, is consumed by only a few people in Los Pilaes. In a similar manner species of this genus are greatly appreciated by the Tepehuanes of Durango (González-Elizondo 1991). *Fomitopsis pinicola* and *Ganoderma* sp. are not used extensively because of their rubbery texture, and *Fuligo septica* due to its soft and gelatinous appearance.

Some genera, such as *Morchella*, are hard to find because they grow in areas that are difficult to reach and have a restricted distribution, even though they are greatly appreciated because of their flavor, as well as for their commercial value. Other mushrooms are not used simply because their flavor is disagreeable or because people either do not like them or do not know how to prepare them.

Mushroom preparation. The recipes used to prepare mushrooms for consumption are diverse and vary according to the custom of each family, their economic situation, and the type of mushroom. Although mushrooms are usually collected for sale, some are picked for consumption at home. In Ixtenco, mushrooms are bought.

The basic ingredients necessary to prepare mushrooms are garlic, onion and salt, depending upon how they are cooked; however, other herbs can be used, such as mint, epazote and pipitza (*Porophyllum tagetoides* (HBK) DC.), laurel, or cinnamon.

In the case of the *pante* (*Boletus pinophilus*), the *amarillo* ('yellow'; *Amanita caesarea*), and the *pancita* (*Suillus granulatus*), the carpophores are cleaned by peeling off the cuticle and cutting off the lower portion of the stem. The *corneta de oyamel* ('fir horn'; *Gomphus floccosus*) are cleaned of their veins and scales because, according to the people, these structures "are rust" due to their bitter taste; in the case of the *corneta blanca* ('white horn'; *Russula delica*), the gills are removed for the same reason. Depending on the flavor, mushrooms may or may not be washed; some people consider that washing eliminates their flavor or makes them slimy as in the case of the *pante*.

The blue mushroom (*Lactarius indigo*), the *pante*, the *paltecosa* (*Chroogomphus jamaicensis*), the *tecocita* (*Cantharellus cibarius*), and the *hongo del maguey* 'mushroom of the maguey' (*Pleurotus opuntiae*) can be eaten roasted or baked. It is recommended that the *pante* be prepared fried in lard with salt, which is said to taste like *chicharrón* (crackling) when prepared in this manner.

The yellow mushroom (*Amanita caesarea*), the *mantecado* (*Amanita rubescens*), the *xolete* (*Lyophyllum decastes*), and the *hongo de pasto* ('grass mushroom'; *Agaricus*



*campestris*), can be fried with slices of chili. The *pante* (prepared as a croquette) and the *escobetas* (*Ramaria* spp.) are recommended mixed with eggs.

Another way to cook them is in soup, with chicken, or just with epazote and onions or with slices of *cuaresmeño* chili. Mushrooms that are prepared in this way are the *escobetas*, the *xoletes*, the *amarillo*, the *hongo de pasto*, the *huevoito* (*Hygrophorus chrysodon*), and the *tejamanil* (*Clitocybe gibba*). Some stews are more sophisticated; they are prepared in *pipián*, with green mole with peas or kidney beans. The *menudito* (*Morchella* spp.) is prepared stuffed with mashed potatoes, cheese, or ground meat, covered with beaten egg and fried. The *hongo de maguey*, the *enchilado* (*Lactarius salmonicolor*), and the *corneta blanca* are ground in the metate with epazote and chili to prepare quesadillas. It is recommended that the *hongo de pasto*, the *tecocita*, and the *xocoyulado* (*Laccaria bicolor*) be boiled with beans.

Mushroom preservation. One way to preserve mushrooms in order to enjoy them "para el antojo" (for cravings) in any season is to dry them in the sun, either sliced (as is the custom in Javier Mina), or strung on a thread (as mentioned by people in Ixtenco and Los Pilares). People from Javier Mina dry great quantities of mushrooms on screens; they take their mushrooms to Mexico City in order to sell them. Their price is greatly increased in this way.

Mushrooms that are customarily dried are the *pante*, the *menudo* or *morilla*, the *tecocita*, and the *orejas* (*Helvella* spp.). Species dried less frequently are the *corneta blanca*, the *corneta de oyamel*, the *escobetas*, and the *xolete*.

*Beauty Treatments.*—*Ustilago maydis* is used in some beauty treatments for refreshing the skin and giving softness. People mix the spores of this fungus with lemon juice and smear the mixture on the face as a mask.

*Decoration.*—Some people from Ixtenco use *Fomitopsis pinicola* (Sow.) Kickx and *Ganoderma* sp. to decorate Nativity scenes at Christmas time. People perforate the centers of the sporophores and use them to represent fountains, rocks or any other element in the display ("crèches"). Some people sell the sporophores of these species in the Huamantla market. We found these species in the market only at Christmas time.

*Tinder.*—Woodcutters and other people who have to stay in the forest for many hours or overnight use dried and old sporophores of *Fomitopsis pinicola* and other big polypore species to light fires to prepare meals or to provide warmth.

*Medicine.*—*Ustilago maydis* (*cuitlacoche*) is used to dress and promote the healing of burns in the three communities. Spores of this species are mixed with cold cream or lard. The mixture is smeared on the burned areas of skin.

*Lycoperdon perlatum* Pers. and other species of *Lycoperdon* (*pedo de coyote* 'coyote's flatulence') are used to heal wounds, burns and blotches. For wounds, the damaged skin is disinfected with alcohol, and the spores are then put on the wound. For burns, the fresh or dried sporophores are used in a similar way to that of *Ustilago maydis*. For skin blotches, it is necessary to clean the affected zone first. Spores are put on two or three times until the blotches dry. People from Javier Mina and Ixtenco mention medicinal uses of *Lycoperdon* spp.

*Amanita muscaria* (L.) Pers. (*yema venenosa* 'poisonous yolk' or *khowiwe* =



*hongos mosca*) is used to heal dysentery in Javier Mina. The mushroom is boiled and the water is drunk as an infusion.

*Pseudevernia consocians* (Vain.) Hale & Culb. and *Ramalina* sp., are used as a cure for pneumonia. These lichens are pulverized and mixed with alcohol, then the mixture is smeared on the chest. Many species of lichens (*flor de piedra* 'stone flower' or *lama de piedra*, 'stone slime') are used to make a tea to heal coughs.

*Insecticide*.—*Amanita muscaria* is used to kill flies. The cap and warts are put into a dish with milk or water mixed with sugar, and set aside indoors.

*Poison*.—Those mushrooms that people do not use for eating are considered to be poisonous. In Ixtenco, people call them *khominikho* (*hongos que no sirven* 'useless mushrooms') or *tsangokho* (*tsango* 'poison' or 'rabies'; *kho* 'mushroom'; Spanish: *veneno* or *rabia* 'mushroom of rabies'). The general names in Spanish for these are *hongos locos* 'crazy fungi' and *hongos malos* 'crazy fungi' in all three localities.

*Commercialization*.—During the rainy season, mushroom selling is a very important activity, especially in Javier Mina, where 73% of people dedicate themselves to this operation. In Javier Mina, 102 families were interviewed. Seventy-five of them (59 women and 16 men) collect and sell mushrooms every day during the rainy season. A family spends 7 to 10 hrs collecting wild mushrooms, and walks about 8 to 20 km round trip. On average, each family collects 5.3 kg obtaining US \$4.25 (29.09 Mexican pesos) per day (1 dollar = 6.85 pesos in 1995). Storeowners in the communities hoard mushrooms throughout the whole season in order to sell them later at a higher price in Puebla and Mexico City, to both local and to foreign buyers (mainly from Argentina). On average storeowners buy 82.23 kg of wild mushrooms per day and pay US \$54.80 (375.35 Mexican pesos), which they resell in Mexico City or Puebla City. The inhabitants of Javier Mina are considered *hongueros* 'mushroom collectors' by the people of the surrounding communities. In Los Pilares, 3% of the interviewed people collect mushrooms to sell in their own community, as well as in the market of Huamantla.

Both large- and small-scale marketing exists. In the first case (only in Javier Mina), the sale is carried out by individuals who own pickup trucks. They take mushroom collectors to distant woods in order to find a greater quantity of mushrooms; the one condition is that the harvest be sold to those providing the transport. In this way, both sides benefit: the collector finds more mushrooms and obtains more money and the buyer also obtains a greater harvest of mushrooms for retail. Hoarders sell both fresh and dehydrated mushrooms; dry mushrooms are more expensive, but the crop must be young and well dried in order to be accepted.

Large-scale mushroom sale is an activity that has both advantages and disadvantages for the inhabitants of the community. The mushroom trade provides some work for children who, besides being collectors, are employed and paid to clean and slice mushrooms. On the other hand, the effect that excessive collecting and over-exploitation has on some species is unknown. In addition, the price paid per kilogram to the collectors is very low in relation to the work and effort involved.

Mushroom price varies according to abundance; when there are many, the



TABLE 4.—Mushroom prices in Javier Mina.

Latin name	Price in 1990 (US \$1 = 2.85 Mexican pesos)	Price in 1995 (US \$1 = 6.35 Mexican pesos)	Price in 2000 (US \$1 = 9.70 Mexican pesos)
<i>Amanita caesarea</i>	\$ 1.05–2.80/kg	Immature carpophores \$ 1.73–2.36/kg Mature carpophores \$ 0.63–0.94/kg	Immature carpophores \$ 2.07/kg Mature carpophores \$ 0.97/kg
<i>Boletus pinophilus</i>	\$ 1.75–3.50/kg	Immature carpophores \$ 0.78–1.10/kg Mature carpophores \$ 0.31–0.47/kg	Immature carpophores \$ 2.07/kg Mature carpophores \$ 0.61/kg
<i>Hebeloma aff. mesophaeum</i>	\$ 0.17–0.87/kg	\$ 0.15–0.55/kg	\$ 0.62/kg
<i>Lyophyllum decastes</i>	\$ 1.75–3.50/kg	\$ 0.94–1.25/kg	\$ 2.07/kg
<i>Lyophyllum ovisporum</i>	\$ 1.75–3.50/kg	\$ 0.78–1.25/kg	\$ 2.07/kg
<i>Morchella esculenta</i>	\$ 2.45–5.26/kg	\$ 0.16–0.31/kg	\$10.39/kg

price diminishes. Table 4 shows the prices per kilogram of some of the main species that are collected in the community of Javier Mina.

Small scale mushroom trading is carried out within the communities, in neighboring communities, and at the marketplace in Huamantla. Here, the only beneficiaries are the mushroom collectors, for there is no middle-man. This is a very important activity; it is carried out by most of the collectors in Los Pilares and in Javier Mina and represents a considerable source of income during the rainy season. When the mushroom season is poor, people dedicate themselves to other related activities such as the collection and sale of Mexican cherries (*capulín*; seed fruits of *Prunus serotina* spp. *capuli* (Cav.) McVaugh.).

According to the information provided, in Ixtenco, the collection of mushrooms for sale in the neighboring communities was once a common activity. Nowadays, however, this activity is sporadic.

GENERAL DISCUSSION

This study provides a brief summary of traditional mycological knowledge from three towns within the same ecological area. Data presented are very similar to those found previously in other places and cultures in Mexico.

Regarding the conceptions about fungi, a high percentage of people from Ixtenco answered that mushrooms are plants, while in Javier Mina and Los Pilares over half of the population interviewed hold this view. Many people answered that these organisms are only “mushrooms,” different from plants, like the conception that Purepechas from Michoacán have (Mapes et al. 1981). The oldest people in Ixtenco also view mushrooms as distinct. They use a special classifier for designating mushrooms, *kho*, which is the same as that used by the Otomies from Acambay, State of Mexico (Estrada-Torres and Aroche 1987).

As in other areas of Mexico, people use specific terms to name the mushrooms structures. Otomies from Ixtenco name the cap (*rüphwi*), scales (*danñi*), and stipe (*rwa*) in the same way that Otomies from the State of Mexico (Estrada-Torres and



Aroche 1987); nevertheless, we did not find any name for volva (Otomies call this structure *rdéshkho* in the State of Mexico). People from Javier Mina name all mushroom structures, and the volva and annulus are considered propagules. They believe that leaving these structures behind in the forest will increase the harvest in future years.

Some traditional practices in Javier Mina should be adopted by other collectors in the studied area because such practices could help to preserve this important resource. This is the result of the belief and understanding about the origin of mushrooms. People leave or bury some portions of the collected carpophores (volvas or stipe bases), and these structures may act as vegetative propagules. As far as we know, no scientific study has been done to evaluate the effectiveness of these practices. Other cultural practices include burning the herb layers of the forest with the aim of propagating some grasses used as fodder and at the same time promoting the production of some fungal species such as *Hebeloma* aff. *mesophaeum*, *Lyophyllum* spp., and *Morchella* spp., which grow in burned places. Such activities indicate some kind of forest management in which one objective is to increase the natural production of different edible species of wild mushrooms. Unfortunately, there is no research relating to the real impact of these practices on the natural production of mushrooms, on species selection, or of its effect on the forest itself. People of the towns are quite conscious of the dangers of uncontrolled fire. However, fires are started anonymously by persons who seemingly control neither the intensity nor the extent of the fire.

On the other hand, local ecological knowledge includes some concepts, such as that of "brothers" or "mates," that may help to convey ectomycorrhizal relationships in educational programs (to encourage sustainable use of forest). That is, mushrooms that are *hermanos* 'brothers' may have a common "mother" in the pine, fir or oak trees. The information that people have acquired could be used to indicate that a relationship exists between trees and mushrooms and something that damages one of them surely affects the other. If the people know that when they cut the pine trees, that is, the "mother" or host of young mushrooms such as *Boletus pinophilus*, then mushrooms will die and in later years they will find fewer of them to harvest. It will be important to make young people aware of the need to care for their forest resources, showing them relationships between different organisms using simple ideas. The information about traditional propagation of mushrooms would also be included in these kinds of programs. It is important to teach that mushrooms have spores, which are the seeds in that, if they leave spore-bearing pieces of the fruiting body, another mushroom may originate the next year in the same place. For this reason, it is important to clean the mushrooms in the forest and to bury unused portions of the sporophore.

Similar data related to mushroom uses have been reported in other parts of Mexico. For example, the Otomies of the State of Mexico (Estrada-Torres and Aroche 1987) use *Amanita muscaria* as an insecticide, as they do in Ixtenco, and Tepehuans from the State of Durango eat some species of *Rhizopogon*, as do people from Los Pilares. Commercialization of edible mushrooms in Javier Mina and Los Pilares is an important activity as is true in San Juan Atzingo, State of Mexico (Palomino-Naranjo 1992). It is important to point out that the use of mushrooms as food and as a market commodity provides an important complement to the



diet and income for many households of these towns, especially in the rainy season.

Traditional knowledge and experience of mushroom collectors, besides our studies of mushroom commercialization in this area, could form the basis for the promotion of rural enterprise, including the packaging of dry mushrooms or canning of some species, such as has been proposed by Martínez-Carrera et al. (1998).

As in Hueyapan, Morelos (De Ávila et al. 1980), the northern mountains from the State of Puebla (Martínez-Alfaro et al. 1983), the Sierra of Ajusco (Gispert et al. 1984), and San Pedro de los Metates, State of Mexico (Estrada-Torres and Arcoche 1987), people from the study area consider mushrooms to be "cold" in the traditional system of medicinal classification, due mainly to their high water content. However, as in Acambay, State of Mexico, some people from Javier Mina consider *Ustilago maydis* to be hot.

Mycological knowledge of the people of Javier Mina is probably very ancient and has survived to the present time through direct transmission from old to young people. This pattern is true also for Los Pilares.

In Ixtenco, old people provided similar information to that given by the young. Although our study did not aim to compare the ethnomycological knowledge between old and young people, it could be important to investigate this topic and to analyze some changes with time. It is possible that ethnomycological knowledge has been affected by local deforestation.

#### NOTES

<sup>1</sup> Hunn, Eugene. University of Washington, letter, November, 2001.

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APPENDIX 1.—Questions used to obtain information about traditional mycological knowledge.

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1. Name
  2. Age
  3. Occupation
  4. Address
  5. Are you familiar with fungi?
  6. Can you explain fungi?
  7. Name the fungi that you know
  8. What are the uses of fungi?
  9. Where do the fungi grow?
  10. When do fungi grow?
  11. How do they originate?
  12. What conditions do they need to come?
  13. What is the quality of fungi? Are fungi cold, hot or warm?
  14. Why is this so?
  15. Do all fungi grow in the same place?
  16. What are the names of the fungi structures? (with picture shown as reference)
  17. Which fungi are edible?
  18. How do you cook mushrooms?
  19. How do you know an edible fungi?
  20. Which fungi are inedible?
  21. What happens if you eat inedible fungi?
  22. Are inedible fungi useful for something?
  23. What remedies are used for people who eat inedible fungi?
  24. Do you know fungi which are used as a remedy?
  25. Do you collect fungi?
  26. Do you buy fungi?
  27. Do you sell fungi?
  28. Which fungi do you sell?
  29. Where do you sell fungi?
  30. Do you know how to preserve fungi?
  31. Do you know how to sow fungi?
  32. Are you familiar with cuitlacoche?
  33. Are they fungi?
  34. What are they?
  35. What is its use?
-



APPENDIX 2.—Species and common names used by people in the visited communities.

Latin name & voucher specimens	Spanish name	Otomi name	Nahua name
<i>Agaricus campestris</i> L. Montoya 1644	champiñón (1,2,3), llanero (1,2,3), hongo de pasto (1,2,3)		
<i>Agaricus</i> sp. Montoya 491, 970	soles (2)		
<i>Amanita caesarea</i> (Scop.) Pers. Montoya 13, 269, 618; Kong 616	ahuevadito (1,2), hongo amarillo (1,2,3), hongo flor (1,2,3), jícara buena (1,3)	<b>kaxkho</b> kax = amarillo kho = hongo	<b>xochinanácatl</b> xochitl = flor nanácatl = hongo
<i>Amanita franchetii</i> (Boud.) Fayod Montoya 754, 613, 530, 644; Kong 1310	yema (2,3)		
<i>Amanita rubescens</i> (Pers.) Gray. Montoya 127, 589	amantecado (2), chintete (1), man- tecado (2)		
<i>Boletus pinophilus</i> Pilát. & Der- mek. Montoya 09.05.1990, 291, 519; Estrada-Torres 2941; Kong 677	esponja (1), el pan (1) ongorao (2), pambazo (2), pante angora (2), pante (2,3), pante blanco (2), pante morenito (2), pante de za- catón (2), seta (2)	<b>khopante</b> kho = hongo <b>khodme</b> dme = poros	<b>xotoma</b>
<i>Boletus atkinsonii</i> Peck. Montoya 1672	pante cimarrón (2)		
<i>Calvatia cyathiformis</i> (Bosc) Mor- gan Montoya 823	cempamil (1,2,3)		
<i>Cantharellus cibarius</i> Fr. Montoya 392, 539, 738; Her- nández-Valencia 32	duraznillo (2,3), flor de durazo (1), tecosa, tecosita (1,2,3)		
<i>Chroogomphus jamaicensis</i> (Murril) O.K. Mill. Montoya 386, 526	clavillo (1), tlalpalteca (2), tecosa moradita (2,3), tlaltecosa (2,3), palteca (2,3)	<b>grawxi</b> = clavillo	
<i>Clavariadelphus truncatus</i> Donk Kong 2144; Montoya 524, 807	flauta (2)		



APPENDIX 2.—(continued)

Latin name & voucher specimens	Spanish name	Otomi name	Nahua name
<i>Climacocystis borealis</i> (Fr.) Kotl. & Pouzar Kong 2099	hongo de palo (1)		
<i>Clitocybe gibba</i> (Pers.) P. Kumm. Montoya 822; Estrada-Torres 2562	güerita (1,2), popotitos (3), sombrerito (1,2,3), tejamanilero (1,3)		
<i>Entoloma clypeatum</i> (L.) P. Kumm. Montoya 843, 986	rosita (2)		xolete rosita* (2,3)
<i>Fuligo septica</i> (L.) F.H. Wigg. Montoya 313	hongo de palo (1,2,3) hongo de tronco (3)		
<i>Gomphus floccosus</i> (Schwein.) Singer Montoya 388, 703	corneta amarilla (1,2,3), corneta colorada (2), Corneta de oyamel (2,3), trompetilla (1,3)	<i>ixibaswa</i> ixi = durazno corneta de oyamel <i>wawikho</i> wawi = oyamel kho = hongo corneta de oyamel	
<i>Gymnopus dryophilus</i> (Bull.) Murrill Montoya 590	señorita (1,2) paragüitas (1,2), popotitos (2)		
<i>Hebeloma</i> aff. <i>mesophaeum</i> Fr. Montoya 1643; Hernández-Díaz 15	hongo de ocote (1,2,3)	<i>kho Tädi</i> kho = hongo tädi = ocote	<i>ocoshalero</i> (2), hongo de ocoshal* (1) (2), xolete amarillito* (2), xolete de ocoshal* (2,3)
<i>Helvella crispa</i> (Scop.) Fr. Montoya 700, 727; Kong 980	gachupín blanco (2), o. de padre blana (2), oreja blanca (2)		
<i>Helvella infula</i> Schaeff. Kong 927	oreja de padre roja (2)		
<i>Helvella lacunosa</i> Afzel. Montoya 206, 252, 516, 554; Estrada-Torres 2339	gachupín negro (2), o. de padre negra (2), ovispo (1), torito (3)		



## APPENDIX 2.—(continued)

Latin name & voucher specimens	Spanish name	Otomi name	Nahua name
<i>Helvella</i> spp.	cresta de gallo (2), gallitos (1), orejas (2,3) oreja de ratón (1,2,3), pata de gallo (1)		
<i>Hygrophorus chrysodon</i> (Batsch.) Fr. Montoya 527, 543	huevo (1,2), lupitas (2), mariquitas (2), palomita (2), rotito (2), niños (1,2,3)		
<i>Hygrophorus purpurascens</i> (Alb. & Schwein.) Fr. Montoya 544	camarón (2)		
<i>Laccariabicolor</i> (Maire) Orton Montoya 583, 418, 761, 1120	cuero blanco (2), moradilla (3), morenito (1)		<i>xocoyul</i> (2), <i>xocoyulado</i> (1,2,3)
<i>Lactarius indigo</i> (Schwein.) Fr. Montoya 706, 739	azul (1,2,3), conreta azul (2), panza de lagartija (2)	<i>kexke kho</i> kexke = azul kho = hongo	
<i>Lactarius salmonicolor</i> Heim et Leclair Montoya 1013, 1027; Kong 711, 751	encilado (1,2,3) trompa de cochino (1,2)		
<i>Lycoperdon perlatum</i> Pers. Montoya 462, 621, 634, 678	hongo de bola (1), bolita de algodón (1), bolita de conejo (1), bolita de borrego (1), pedo de coyote (1,2,3), pedo de monja (1)	<i>rpich min kho</i> pich = pedo min = coyote pedo de coyote	
<i>Lyophyllum decastes</i> (Fr.) Sing. Montoya 336, 971, 1126	hongo blanco (2), Clavo (2)		<i>iztacnanácatl</i> (2) <i>iztac</i> = blanco <i>nanácatl</i> = hongo <i>xolecte</i> (2), (it must be very delicate, <i>xolectle</i> is one easily hurt; De Ávila et al., 1980) <i>xolecte blanco*</i> (1)



## APPENDIX 2.—(continued)

Latin name & voucher specimens	Spanish name	Otomi name	Nahua name
<i>Lyophyllum ovissporum</i> (Lange) Reid. Montoya 962	blanco de mata (2), hongo de temporal (2)		xolete de temporal* (2,3)
<i>Lyophyllum</i> sp. Montoya 968	coxcomo (2), cuatcomo (2), cuscomo (2), blanco de mata (2), curesmeño (1,2,3) pechuga de gallina (2,3), tecoxcomo (2,3), hongo de trueno (3)		
<i>Morchella elata</i> Fr. Hernández-Valencia 29; Hernández-Díaz 58	chipotle (1,2,3) chultepín, elotito, morilla (2), menudo (1,2,3) Olote (1), Viejito (3)	<i>honti'ñi</i> = chile = chipotle	
<i>Morchella esculenta</i> (L.) Pers. Montoya 857	chipotle (1,2,3) chultepín, elotito, morilla (2), menudo (1,2,3) olote (1), viejito (3)	<i>honti'ñi</i> = chile = chipotle	
<i>Pleurotus opuntiae</i> (Durieu & Lévl.) Sacc. Montoya 974	hongo de maguey (1,2,3)	<i>kho wadá</i> <i>kho</i> = hongo <i>wadá</i> = maguey	
<i>Ramaria flavobrunescens</i> (Atk.) Comer. Estrada-Torres 2499	escobeta amarilla (1,2) escobeta cremita (2)		
<i>Ramariarubripermanens</i> Marr. & Stunz. Montoya 608, 636; Estrada-Torres 2246, 2353	escobeta morada (2)		
<i>Ramaria</i> spp.	escobeta (1,2,3)	<i>ntsani'kho</i> ntsani = escobeta kho = hongo	
<i>Rhizopogon</i> aff. <i>michoacanicus</i> Trappe & Guzmán Montoya 397	papas (3), mollejas (2)		



APPENDIX 2.—(continued)

Latin name & voucher specimens	Spanish name	Otomi name	Nahua name
<i>Russula delicata</i> Fr. Montoya 497, 535; Kong 2255, 2705	borreguitos (2), corneta blanca (2), tecajete (2), pata de cabra (1,3)		
<i>Suillus brevipes</i> (Pk.) Kuntze Montoya 609 <sup>a</sup>	pancita de llano (3)		
<i>Suillus granulatus</i> (Pk.) Kuntze Montoya 326	chipó de toro (3), panza (1,2,3), pancita (1,2,3), pancita de zaca- tón (1,2,3), poposo (2) cailita (2,3)		
<i>Tricholoma flavovirens</i> (Pers.) S. Lundell Montoya 196, 210, 486; Estrada-Torres 2676; Kong 951			
<i>Ustilago maydis</i> (D.C.) Cordá Montoya 973		<i>döntha-kho</i> milpa-hongo = cuitlacoche	<i>cuitlacoche</i> (1,2,3)

Key: 1—Ixtenco, 2—Javier Mina, 3—Los Pilares; \*—mixed names (Nahua/Spanish)







APPENDIX 3.—(continued)

Species	Months											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
<i>Fuligo septica</i>						*****	*****					
<i>Gomphus floccosus</i>						XXXX *****						
<i>Hebeloma</i> aff. <i>mesophaeum</i>							*****					
<i>Helvella crispa</i>							*****					
<i>Helvella lacunosa</i>							*****					
<i>Hygrophorus chrysodon</i>							*****	***** OOOO	*****			
<i>Laccaria bicolor</i>									***** OOOOOOOOOOOO			
<i>Lactarius salmonicolor</i>									OOOOOOOOOOOOOOOO			
<i>Lycoperdon perlatum</i>									OOOOOOOOOOOOOOOO			



APPENDIX 3.—(continued)

Species	Months											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
<i>Lyophyllum decastes</i>				****	xxxx	*****	*****	*****				
		oooo		oooo	oooooooooooooooooooo	oooooooooooooooooooo	oooooooooooooooooooo	oooooooooooo				
<i>Lyophyllum ovisporum</i>			*****									
			oooooooooooooooooooo									
<i>Morchella esculenta</i>									*****	*****		
						oooooooooooooooooooo	oooooooooooooooooooo	oooooooooooo				
<i>Pleurotus opuntiae</i>						xxxxxxxxxxxxxxxxxxxxxx						
								oooo				
<i>Ramaria</i> spp.									*****			
									oooooooooooooooooooo			
<i>Rhizopogon</i> aff. <i>michoacanicus</i>								oooo				
<i>Russula delica</i>								xxxx				
						*****	*****	*****	*****			
								oooo		oooo		
<i>Suillus granulatus</i> and <i>S. brevipes</i>						*****	*****	*****				
						oooooooooooooooooooo	oooooooooooooooooooo					



APPENDIX 4.—Places where mushrooms grow.

	Ixtenco	Javier Mina	Los Pilares
Agricultural fields (Sp.: <i>el campo</i> )	Corn fields <i>Ustilago maydis</i> Parasitic on magueyes <i>Pleurotus opuntiae</i>	Corn fields <i>Ustilago maydis</i> Parasitic on magueyes <i>Pleurotus opuntiae</i>	Corn fields <i>Ustilago maydis</i> Parasitic on magueyes <i>Pleurotus opuntiae</i>
	Grasslands <i>Agaricus campestris</i> <i>Calvatia yathiformis</i> <i>Lycoperdon perlatum</i>	Grasslands <i>Agaricus campestris</i> <i>Lycoperdon perlatum</i>	Grasslands <i>Agaricus campestris</i>
Grasslands (Sp.: <i>el llano</i> )			
The mountain (Sp.: <i>el monte</i> )	Oak forest <i>Amanita caesarea</i> <i>Lactarius indigo</i> <i>Lyophyllum decastes</i> Pine forest (Sp.: <i>ocotal</i> ): <i>Boletus pinophilus</i> (associated with grasses) <i>Laccaria bicolor</i> <i>Ramaria</i> spp. <i>Russula delicata</i> <i>Hebeloma</i> aff. <i>mesophaeum</i> (burned areas) On fallen pine wood <i>Fomitopsis pinicola</i> <i>Ganoderma</i> sp.	Oak forest <i>Boletus atkinsonii</i> <i>Lactarius indigo</i> (in cattle ranch, Sp.: <i>potreros</i> ) Pine forest (Sp.: <i>ocotal</i> ): <i>Amanita caesarea</i> <i>Boletus pinophilus</i> (associated with grasses) <i>Hebeloma</i> aff. <i>mesophaeum</i> (burned areas) <i>Lycoperdon perlatum</i> <i>Lyophyllum decastes</i> (burned areas) <i>Morchella</i> spp. (burned areas) <i>Rhizopogon</i> aff. <i>michoacanicus</i> (underground) <i>Suillus brevipes</i> Pine-alder forest (Sp.: <i>ailites</i> ) <i>Amanita muscaria</i> <i>Boletus pinophilus</i> Fir forest (Sp.: <i>oyameles</i> ) <i>Gomphus floccosus</i> <i>Lactarius salmonicolor</i> <i>Helvella crispa</i> (on moss) <i>Helvella lacunosa</i> (on moss) <i>Morchella</i> spp. (on moss) In ravines <i>Lactarius salmonicolor</i> <i>Morchella</i> spp. <i>Russula delicata</i> On fallen pine wood <i>Fuligo septica</i> <i>Fomitopsis pinicola</i>	Pine forest (Sp.: <i>en la ocotera</i> ) <i>Amanita caesarea</i> (associated with grasses) <i>Boletus pinophilus</i> (associated with grasses) <i>Cantharellus cibarius</i> (among leaf trees) <i>Hygrophorus chrysodon</i> (among leaf trees) <i>Ramaria</i> spp. <i>Russula delicata</i> (among leaf trees) Fir forest <i>Cantharellus cibarius</i> (among leaf trees) <i>Gomphus floccosus</i> (among leaf trees) <i>Helvella crispa</i> (on moss) <i>Helvella lacunosa</i> (on moss) <i>Morchella</i> spp. (on moss) On fallen pine wood <i>Climacocystis borealis</i> <i>Fuligo septica</i> <i>Fomitopsis pinicola</i>